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ELECTROMAGNETIC TREATMENT OF BOILER  
FEED WATER

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Foreign Technology Division  
Wright-Patterson Air Force Base, Ohio

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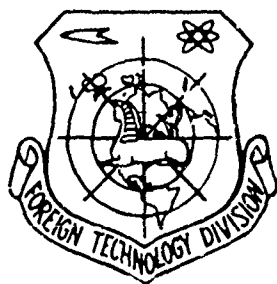
## FOREIGN TECHNOLOGY DIVISION



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OF BOILER FEED WATER

by

P. T. Lyubarets



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## ELECTROMAGNETIC TREATMENT OF BOILER FEED WATER

P. T. Lyubarets, Chief Engineer of  
the "Krasnyy Klyuch" Plant

There has recently been initiated the extensive application of an electromagnetic method of boiler feed water treatment consisting essentially in having the fresh water, before it enters the steam boiler, pass through a magnetic field generated in a special apparatus. Experience has shown that with this treatment technique no hard scum forms in the boilers or heat exchange equipment. The salts associated with the hardness of the water are precipitated in the form of a sludge easily removed during the periodically scheduled washing or scavenging of the boilers, while any older scum that may have developed is broken down and likewise transformed into sludge.

Despite the fairly wide use of this electromagnetic method, its theoretical aspects have not yet been thoroughly researched, with the result that data are not available for the calculation of equipment productivity, parameter selection, and operational control.

It should be noted that in addition to its positive advantages, the electromagnetic method is not without shortcomings. Instances of boiler malfunctions have been reported in the literature. For

example, cases are known when boilers have malfunctioned as a result of the obstruction of the pipes by sludge that accumulated because of inadequate scavenging and as the old scum broke down. There have also been instances when the electromagnetic water treatment apparatus connected to the feed system has failed, but the failure went undetected and the boiler received ordinary untreated water over an extended period. Following the activation of the repaired apparatus the scum which managed to form during this time would decompose, blocking the pipes and causing a malfunction.

The electromagnetic feed water treatment method has been in use at the "Krasnyy Klyuch" Paper Plant for over two years. Because of the simplicity in the design and operation of the equipment, it has been possible to dispense with chemical purification of the water using sodium-cationite filters. The experience acquired in the electromagnetic treatment of feed water has enabled plant efficiency experts to develop a reliable equipment design and technique for the periodic scavenging of [DKV-6-5-13-300] (ДКВ-6-5-13-300) boilers.

Figure 1 shows an apparatus for the electromagnetic treatment of feed water, the design of which was borrowed from a plant at Alma-Ata. The unit consists of a housing (tube), built into which is an electromagnet core with six series-connected coils. The core is enclosed in a hermetically sealed vessel produced from some nonmagnetic material (copper, brass, aluminum, etc.) whose purpose is to protect the electromagnet coils against moisture. A suspension system is used to secure the magnet to the tube, with the coil leads brought out through an opening in the suspension. There are stops on the vessel in order to maintain an identical gap between it and the housing.

The electromagnet winding leads are connected to a 110-volt (0.3 ampere) direct-current power supply. The electrical circuit in use

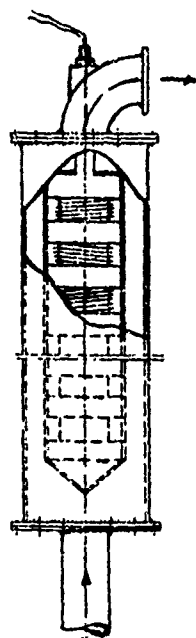


Fig. 1. Basic diagram of electromagnetic apparatus.

at the plant (Fig. 2) permits the connection of the system to the alternating current net. This arrangement offers great convenience in that it makes possible the monitoring of equipment performance and the variation of its parameters (current and magnetic field strength).

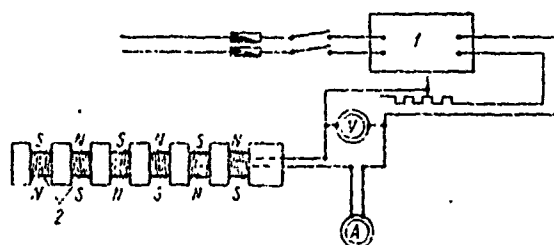


Fig. 2. Electrical diagram of feed water purification apparatus: 1 - VSA-4 selenium rectifier; 2 - coil, PELSHO-grade wire.

The apparatus is installed on the pipeline carrying fresh water to the feed tanks. Operational experience brought to light the following structural defects: the difficulty of producing an entirely air-tight vessel of nonmagnetic material; problems in the replacement of the magnet in the event of coil failure; unreliable coil performance because of the severe temperature difference



between the vessel walls and the magnet, causing the condensation of the vapor contained in the air trapped in the vessel.

Together with mechanic Ye. I. Pogudin and electrical engineer V. M. Klimenko the author has devised an improved version of the apparatus as shown in Fig. 3. This version differs from the original one in that in place of a vessel a tube of nonmagnetic material is mounted in the housing by means of blank flanges. From above, this tube is secured by a female screw, from below - by a dome nut. The magnet is inserted into the upper open aperture of the tube. The tube's free space is filled with transformer oil.

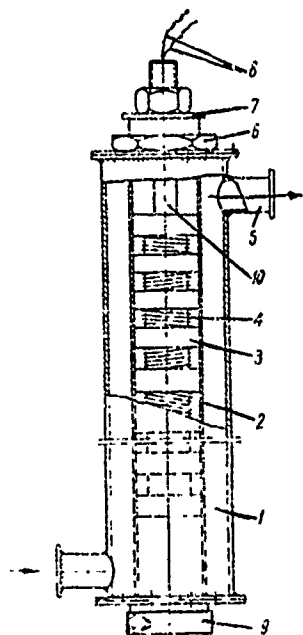


Fig. 3. Improved electromagnetic treatment apparatus; 1 - housing; 2 - inner tube; 3 - magnet; 4 - coils; 5 - outlet pipe; 6 - nut; 7 - tube cover; 8 - power supply connection; 9 - lower nut; 10 - suspension.

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This unit has been operating faultlessly at the "Krasnyy Klyuch" Plant for about a year and a half. It is so designed that if the magnet fails, it can be replaced without disconnecting the apparatus from the pipeline system.

Experience has shown that the electromagnetic treatment of boiler feed water eliminates completely the problem of scum formation and that the successful employment of this method depends

mainly not so much on the selection of the parameters (voltage, amperage, and magnetic field strength) as on the proper solution to the problem of sludge removal, especially from the DKV boilers with their shielded surfaces. The boiler scavenging technique adopted at the plant did not provide uniform sludge removal, with the consequence that there were buildups in certain boiler sections. For better sludge removal, additional nozzles have been welded to the boiler for scavenging its surface collectors, with piping mounted in the upper and lower drums.

These measures, along with the established precise scavenging procedure and its rigorous enforcement, have made it possible to achieve good results in the electromagnetic treatment of feed water.